AMENDMENTS TO THE CLAIMS

1. (Previously Presented) A radar device including:

an antenna for receiving as reception waves radio waves coming from a plurality of external targets;

a signal detector for converting the reception waves received by the antenna into received signals to extract quantities characterizing the received signals; and

a position/velocity computing unit for calculating, from the received-signal characterizing quantities extracted by the signal detector, observed position values and observed velocity values of each of the external targets; the radar device characterized by

a target tracking filter for performing a correlation process, based on first gates, on the observed position values and the observed velocity values calculated by the position/velocity computing unit, to calculate, from the observed position values and the observed velocity values that satisfy the first gates, smoothed values of the positions and velocities of each of the external targets;

a clustering unit for, when external targets are close to each other, creating a cluster to include the external targets, based on the smoothed values of the positions of each of the external targets; and

an intra-cluster target tracking filter for performing a correlation process, based on second gates, on the observed position values and the observed velocity values of the external targets belonging to the cluster formed by the clustering unit, to calculate, from the observed position values and the observed velocity values that satisfy the second gates, smoothed values of the positions and velocities of each of the external targets.

2. (Cancelled)

3. (Currently Amended) A radar device <u>comprising:</u>

<u>an antenna for receiving as reception waves radio waves coming from a plurality of external targets;</u>

<u>a signal detector for converting the reception waves received by the antenna into received signals to extract quantities characterizing the received signals;</u>

<u>a position/velocity computing unit for calculating, from the received-signal characterizing quantities extracted by the signal detector, observed position values and observed velocity values of each of the external targets;</u>

<u>a target tracking filter for performing a correlation process, based on first gates, on the observed position values and the observed velocity values calculated by the position/velocity computing unit, to calculate, from the observed position values and the observed velocity values that satisfy the first gates, smoothed values of the positions and velocities of each of the external targets;</u>

<u>a clustering unit for, when external targets are close to each other, creating a cluster to include the external targets, based on the smoothed values of the positions of each of the external targets; and</u>

<u>an intra-cluster target tracking filter for, while regarding the cluster formed by the clustering unit as a single external target, calculating, from the observed position values and the observed velocity values calculated by the position/velocity computing unit,</u>

smoothed values of cluster parameters expressing features of the cluster~~according to~~

~~claim 2~~, wherein, when two external targets are present, the intra-cluster target tracking

filter calculates, as the smoothed values of the cluster parameters, smoothed values of the

midpoint of the external target positions, of the velocity of the midpoint, of the distance

between the external targets, and of the rate at which the distance varies over time.

4. (Currently Amended) A radar device <u>comprising:</u>

<u>an antenna for receiving as reception waves radio waves coming from a plurality</u>

<u>of external targets;</u>

<u>a signal detector for converting the reception waves received by the antenna into</u>

<u>received signals to extract quantities characterizing the received signals;</u>

<u>a position/velocity computing unit for calculating, from the received-signal</u>

<u>characterizing quantities extracted by the signal detector, observed position values and</u>

<u>observed velocity values of each of the external targets;</u>

<u>a target tracking filter for performing a correlation process, based on first gates,</u>

<u>on the observed position values and the observed velocity values calculated by the</u>

<u>position/velocity computing unit, to calculate, from the observed position values and the</u>

<u>observed velocity values that satisfy the first gates, smoothed values of the positions and</u>

<u>velocities of each of the external targets;</u>

<u>a clustering unit for, when external targets are close to each other, creating a</u>

<u>cluster to include the external targets, based on the smoothed values of the positions of</u>

<u>each of the external targets; and</u>

      an intra-cluster target tracking filter for, while regarding the cluster formed by the

clustering unit as a single external target, calculating, from the observed position values

and the observed velocity values calculated by the position/velocity computing unit,

smoothed values of cluster parameters expressing features of the cluster~~according to~~

~~claim 2~~, wherein, when three or more external targets are present, the intra-cluster target

tracking filter calculates, as the smoothed values of the cluster parameters, smoothed

values of the weighted center of a polygon whose vertices are on the positions of the

external targets, of the velocity of the weighted center, of the distances between the

external targets, and of the rates at which the distances vary over time.

5. (Currently Amended) A radar device according to claim 1, 3, or 4 ~~or 2~~, wherein, when

the first gates for a plurality of external targets belonging to the cluster overlap, the intra-

cluster target tracking filter performs the correlation process based on second gates

created by dividing the first gates at the weighted center of the external targets.

6. (Currently Amended) A radar device according to claim 1, 3, or 4 ~~or 2~~, wherein, when

the first gates for a plurality of external targets belonging to the cluster overlap, a buffer

area is provided in the vicinity of the weighted center of the external targets, and the

intra-cluster target tracking filter performs the correlation process based on second gates

created by dividing the first gates so as to contact the outer border of the buffer area.

7. (Currently Amended) A radar device according to claim 1, 3, or 4 ~~or 2~~, wherein

the target tracking filter further calculates predicted values of the distances

between the external targets; and

the clustering unit calculates the variance of the predicted values of the distances,

determines a predetermined threshold based on the variance, and forms the cluster when

the distances between the external targets are not larger than the threshold.

8. (Currently Amended) A radar device according to claim 1, 3, or 4 or 2, wherein the

intra-cluster target tracking filter determines, based on the distance from the weighted

center of a polygon whose vertices are on the positions of the external targets, gains for

determining contributions of the observed values in calculating the smoothed values.

9. (Currently Amended) A radar device according to claim 1, 3, or 4 or 2, wherein

the antenna radiates toward the external targets a reference signal having an up

phase for continuously increasing the frequency and a down phase for continuously

decreasing the frequency as transmission waves having beam patterns in a plurality of

directions;

the signal detector generates, in the up phase and in the down phase, beat signals

from the received signals and the reference signal; and

the position/velocity computing unit calculates, from the beat signals in the up

phase and the beat signal in the down phase, relative velocities and relative distances of

the external targets, calculates directions of the external targets from differences in

quantities characterizing the beat signals in adjacent beam patterns, and calculates, from

the relative velocities, the relative distances, and the directions, the observed position

values and the observed velocity values of the external targets.

10. (Previously Presented) A radar device according to claim 9, wherein the radar device

is installed in an automobile.

11. (New) A method of tracking objects with a radar device, the method comprising:

receiving as reception waves radio waves coming from a plurality of external

targets;

converting the reception waves received into received signals to extract quantities

characterizing the received signals;

calculating, from the received-signal characterizing quantities, observed position

values and observed velocity values of each of the external targets;

correlating, based on first gates, on the observed position values and the observed

velocity values, to calculate, from the observed position values and the observed velocity

values that satisfy the first gates, smoothed values of the positions and velocities of each

of the external targets;

clustering to create a cluster, when external targets are close to each other, that

includes the external targets, based on the smoothed values of the positions of each of the

external targets; and

intra-cluster tracking and calculating, based on second gates, on the observed

position values and the observed velocity values of the external targets belonging to the

cluster formed by clustering, to calculate, from the observed position values and the

observed velocity values that satisfy the second gates, smoothed values of the positions

and velocities of each of the external targets.

12. (New) A method of tracking objects with a radar device, the method comprising:

      receiving as reception waves radio waves coming from a plurality of external

targets;

      converting the reception waves received into received signals to extract quantities

characterizing the received signals;

      calculating, from the received-signal characterizing quantities, observed position

values and observed velocity values of each of the external targets;

      correlating, based on first gates, on the observed position values and the observed

velocity values, to calculate, from the observed position values and the observed velocity

values that satisfy the first gates, smoothed values of the positions and velocities of each

of the external targets;

      clustering to create a cluster, when external targets are close to each other, that

includes the external targets, based on the smoothed values of the positions of each of the

external targets; and

      intra-cluster tracking and calculating, while regarding the cluster as a single

external target, from the observed position values and the observed velocity values,

smoothed values of cluster parameters expressing features of the cluster, wherein, when

two external targets are present, said tracking and calculating calculates, as the smoothed

values of the cluster parameters, smoothed values of the midpoint of the external target

positions, of the velocity of the midpoint, of the distance between the external targets,

and of the rate at which the distance varies over time.

13. (New) A method of tracking objects with a radar device, the method comprising:

       receiving as reception waves radio waves coming from a plurality of external

targets;

       converting the reception waves received into received signals to extract quantities

characterizing the received signals;

       calculating, from the received-signal characterizing quantities, observed position

values and observed velocity values of each of the external targets;

       correlating, based on first gates, on the observed position values and the observed

velocity values, to calculate, from the observed position values and the observed velocity

values that satisfy the first gates, smoothed values of the positions and velocities of each

of the external targets;

       clustering to create a cluster, when external targets are close to each other, that

includes the external targets, based on the smoothed values of the positions of each of the

external targets; and

       intra-cluster tracking and calculating, while regarding the cluster as a single

external target, from the observed position values and the observed velocity values,

smoothed values of cluster parameters expressing features of the cluster wherein, when

three or more external targets are present, said tracking and calculating calculates, as the

smoothed values of the cluster parameters, smoothed values of the weighted center of a

polygon whose vertices are on the positions of the external targets, of the velocity of the

weighted center, of the distances between the external targets, and of the rates at which

the distances vary over time.

14. (New) The method according to claim 11, 12, or 13 wherein

   correlating further comprises calculating predicted values of the distances

between the external targets; and

   clustering further comprises:

      calculating the variance of the predicted values of the distances;

      determining a predetermined threshold based on the variance; and

      forming the cluster when the distances between the external targets are not

   larger than the threshold.